



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

The genus *Crataegus*, with some theories concerning the origin of its species*

HARRY B. BROWN

Doubtless the genus *Crataegus* has puzzled systematic botanists more the past decade or two than has any other genus of phanerogamic plants. A number of careful workers have been studying the genus for several years but as yet only tentative conclusions have been reached.

In Gray's *Field, Forest, and Garden Botany*, published in 1857, there was listed for the states east of the Mississippi River, twelve species and two varieties of *Crataegus*. This included both wild and cultivated species. Ten species and four varieties were listed in the edition of Gray's *Manual of Botany* published in 1867. This included both wild species and species escaped from cultivation. In Chapman's *Flora of the Southern United States*, published in 1860, eleven species and one variety were described. These were largely the same as the species described in Gray's *Manual*, only three being different. In Coulter's *Manual of the Botany of the Rocky Mountain Region*, published in 1885, four species were described; two of these were included in Gray's *Manual*. In the *Cayuga Flora*, published in 1886, there were six species and one variety; this included the species of the Cayuga Lake basin. Focke's estimate in Engler & Prantl, *Die Natürlichen Pflanzenfamilien*, published in 1888, was that there were thirty to forty species growing in the north temperate zone. In the edition of Gray's *Manual* issued in 1889, there were only ten species and four varieties described. Chapman's *Flora of the Southern United States*, published in 1897, gives but fifteen species coming within its range, but about this time something happened to the genus, apparently — species seemed suddenly to become much more abundant. In Britton's *Manual*, issued in 1901, thirty-one species were described. This covered the northern states and extended westward to about the 100th meridian. In Small's *Flora of the Southeastern United*

* Contribution from the Department of Botany of Cornell University, No. 139.

States, published in 1903, one hundred and eighty-five species were described — an increase of one hundred and seventy in just six years, for Chapman, covering practically the same region, had fifteen in 1897. Sargent's *Trees of North America*, issued in 1905, contained descriptions of one hundred and thirty-two species having characters such that they can be called trees. This covered all of North America, north of Mexico.

During the past two years new works appeared — Britton's *North American Trees* and Gray's *New Manual of Botany*. The genus *Crataegus* was treated by W. W. Eggleston in both of these works. He favors the reduction of the number of species to the narrowest limits possible. In the work on trees, he lists fifty-one species large enough to be called trees, or tree-like in form; in Gray's *New Manual*, sixty-five species and about fifty varieties are described.

After devoting a limited amount of time to the study of the forms of the local flora of the Ithaca region, with the help of Mr. Eggleston and Mr. John Dunbar of Rochester, we have identified about thirty species and four or five varieties.

Prior to 1896, about one hundred North American species of *Crataegus* had been described; of these a large percentage are not tenable. Since 1896, eight hundred and sixty-six species and eighteen varieties have been described (most of them since 1900). The proposers of these are as follows:

E. L. Greene,	1 species.	
G. V. Nash,		1 variety.
J. K. Small,	1 species.	
A. A. Heller,	1 species.	
T. Howell,	1 species.	
C. H. Peck,	1 species,	1 variety.
J. H. Schuette,	1 species,	3 varieties.
F. Ramaley,	2 species.	
C. L. Gruber,	3 species,	2 varieties.
A. Nelson,	4 species.	
N. L. Britton,	8 species,	2 varieties.
W. W. Eggleston,	10 species,	3 varieties.
C. D. Beadle,	144 species.	
W. W. Ashe,	165 species.	
C. S. Sargent,	524 species,	6 varieties.

Many parts of the country have not yet been worked over thoroughly, and new descriptions are bound to appear for some time to come.

Species do not seem to be so abundant in western North America or in other parts of the world. Howell's Flora of Northwest America includes but two species ; Jepson's Flora of Western Middle California, one ; Rydberg's Flora of Colorado, but five ; and the Coulter-Nelson New Manual of Botany of the Central Rocky Mountains, nine. There are about twelve species from the Rocky Mountains west, north of Mexico. Grisebach lists none in the Flora of the British West Indian Islands. In Bentham and Hooker's Genera Plantarum, but twelve species are said to be found in Europe, Asia, and Japan. It remains to be seen whether or not many more species will be found in these regions upon closer study.

A consideration of the foregoing facts brings up a number of interesting questions. Why did not the systematists discover the great number of species years ago ? We cannot say they did not do careful work. Can it be that the number of species has multiplied greatly within the last few decades ? Have the older species been hybridizing so that many of the forms at present are hybrids ?

In order to get some light on some of these questions the following list of questions was sent to each of the following men, who are regarded as leading students of the genus in this country : C. S. Sargent, W. W. Eggleston, W. W. Ashe, C. D. Beadle, Ezra Brainerd, and John Dunbar.

1. Why did not the systematic botanists discover the large number of species of *Crataegus* years ago ?
2. Do you consider the species now being described elementary species ?
3. Do the species breed true or come true to seed ?
4. Will different species hybridize ?
5. Do you consider the numerous species to have arisen as mutations ?

Professor Sargent, director of the Arnold Arboretum, has perhaps devoted more time to the study of the genus than has any other man and has described many new species. In answer to the questions, he says :

1. Because they did not use their eyes and were satisfied to take for granted that what had been published about the genus was correct and final.

2. I do not know what you mean by elementary species.

3. We have planted in all nearly three thousand numbers of seeds at the Arboretum and so far have found no evidence that the different species do not come true from seed. In fact the seedlings of no other genus that has been raised here have shown such a remarkable resemblance to the parent plants.

4. We have never found here any evidence that the different species hybridize.

5. I cannot answer this question.

W. W. Ashe, of the Forest Service, U. S. Department of Agriculture, has studied East-American species of *Crataegus* considerably. His answers are :

1. The species of *Crataegus* were not recognized earlier because the material was studied entirely in a dry state, in which distinctive characters are very largely lost. It was not uncommon to find in the largest collections specimens of most different forms from widely separated parts of North America bearing the same name. Several groups even were not recognized ; for example, *Intricatae*, all species of which were called "*coccinea*."

2. Some of the species now being proposed are undoubtedly elementary. Most of them, however, are certainly not. The 10- and 20-stamened forms with slight accompanying differences in fruit, or differences in anther color with slight accompanying differences in fruit are clearly elementary species. When differences extend to inflorescence, size of flowers, and foliage, the sum of the correlated characters may be regarded as entitling the form to full specific rank.

3. Many of the species are known to breed true through their seed. Most of them have not been sufficiently tested for conclusive proof.

4. Many species hybridize and some of those which have been proposed are undoubtedly hybrids. Hybrids are probably no more numerous, however, than between the nearly related species of American oaks. It is also undoubtedly true that some of the

species and groups based on the number of stamens are not valid, since I am now pretty sure that forms of some species may have either ten or twenty stamens.

5. Some of the species probably originated as mutations. The limit of fluctuating variation is undoubtedly wide in some groups, but there is frequently a correlation of characters in the species which in their stability suggests elementary species rather than more instable variation of mutation. Some of the forms in the *Molles* group, in Missouri and Illinois, would seem to be mutations, leading to the inference that some species of this group have originated in this manner. The variation in the *Pruinosae* in the Appalachians and the localized valley species also indicate mutation origin.

C. D. Beadle, director of the Biltmore Herbarium, at Biltmore, N. C., has made an extended study of southern forms of *Crataegus*. His answers are as follows :

1. It is necessary to know the complete history of the *Crataegus* species before an understanding of its status is possible. A parallel is well typified in the study of *Viola*, where a knowledge of the complete vegetative phases of each species must be understood in order to differentiate them. The earlier systematic botanists worked largely in the herbarium. The opportunity of dissolving the mysteries of the *Crataegus* genus may be gained only in the field and by studying groups of marked trees.

2. Yes and no. There is a large number of *Crataegus* species undoubtedly ; and, no doubt, there is much duplicating in the specific publications by the different authors who are working altogether too independently of each other's discoveries.

3. Yes, I proved that they come true to seed before daring to publish a new species in this field.

4. Very probably they hybridize.

5. Yes, they are mutations.

W. W. Eggleston, of the New York Botanical Garden, is another distinguished student of the genus. He has studied the specimens in all of the larger herbaria of the country, the living plants in the different arboreta, and for a decade or more he has been making an extended study of plants in the field in various

parts of the country, especially in the eastern half of the United States. He, as was stated above, believes in reducing the number of species; he does this by making certain species of different authors equivalent, and by reducing other species to the rank of varieties. His discussion in regard to the questions is as follows:

Systematic botanists did not know the species in America largely because they never saw them. The Gray Herbarium and the Torrey Herbarium were both very scanty in *Crataegus*. The manuals took most of the forms they had. The coastal plain has very few *Crataegi*, and that is where a large share of the early collecting was done. The European botanical gardens had many more American species than were known here, and it is through them that the work commenced.

Crataegus plants produce much good seed and the plantations at Biltmore, Arnold Arboretum, and at the New York Botanical Garden, show that the forms of the genus reproduce themselves surprisingly from the seed (leaf characters only; trees mostly not yet fruiting). They doubtless will hybridize, and there are probably mutations, too.

Dr. Ezra Brainerd, ex-president of Middlebury College, Middlebury, Vt., was another authority questioned. He writes:

The queries that you raise in your letter of Nov. 15 regarding *Crataegus* are queries that have been puzzling me for over six years, and I am not even yet prepared to answer them with any positiveness. The problem is part of a larger one that I have been diligently studying as it is presented in the genus *Viola*; and here with very satisfactory results. Experimental work in *Crataegus* is difficult, as in this genus it is about 7 to 10 years from generation to generation; *Viola* affords a new generation each year. So I shall be able to give only brief and inadequate answers to your questions.

1. I fancy the systematic botanists did not "discover the large number of species of *Crataegus* years ago," because (a) they had broader conceptions of what constitutes a species than most modern botanists have; many recently made species used to be considered mere forms or varieties; (b) the genus *Crataegus*, I believe, has vastly increased in individuals and in "forms" in the northeastern U. S. since the forests were cut off; specimens are rarely found in the original forests of this region. But the plants rapidly take

possession of neglected pastures, fence-rows, and untilled ledges ; (c) the older botanists had no time for the intensive study of a genus of numerous closely allied forms, such as *Crataegus*.

2. Many or most of "the large number of species now being described," if proper species at all, would have to rank as "elementary species." But some recently made species are, I believe, mere "fluctuations" or "forms."

3. I have never raised seedlings of *Crataegus* ; Dr. Sargent has in large quantities, and he insists on it that as respects foliage they breed true to seed.

4. I must confess I have never attempted to hybridize *Crataegus* species ; I know of no one who has attempted it with our American species. The few species of Europe cross in many ways (see Focke's *Pflanzen-mischlinge*, p. 146). I know of several cases of what appear to be natural hybrids, "local species," each quite intermediate between the two supposed parent species with which it is associated. The Rosaceae are of all orders most predisposed to hybridize. *Rosa*, *Rubus*, *Geum*, *Amelanchier*, and *Malus* are notorious for the forms resulting from interbreeding. By analogy we should expect the same condition of things in *Crataegus*. The array of closely allied forms (hardly distinguishable even by an expert) present a condition of things in *Crataegus* that is perfectly paralleled in *Rubus*, *Rosa*, and *Viola*. The multiplicity of even stable forms that may result (in the working out of Mendel's Laws) from one pair of parents is astonishing. The swarms of "elementary species," I suspect, have in some instances come about in this way.

5. There may be "mutations" in *Crataegus* ; but it would be very hard to prove.

John Dunbar, of the Park Department, Rochester, N. Y., is another enthusiastic student of the genus. In answering the questions, he says :

1. No doubt they (the early systematists) believed honestly, without thorough investigation, that the large number of variations, which, of course, they could not help but detect, were mere forms of several species.

2. They are true species.

3. They do breed true. The progeny come with remarkable fidelity to the specific typical characters of the parents.

4. They may hybridize, but I have seen no evidence of it.

5. I have not given much attention to the conception of mutation in regard to the origin of species. It may be true. In the meantime I am inclined to believe in the Darwinian theory, that natural selection with other agencies, acting on varieties, and extending over a long period, has produced these *Crataegus* species, and all other species. The fact that the thorns are exceedingly hardy, virile, and distributed over a large area, and well fitted to maintain the struggle for existence, no doubt has given them a tendency to much variation, and in the course of many generations these inherited "traits" have become fixed and specific, and hence, new species, after a long lapse of time, appeared.

From studies, observations in the field, and what has been learned from special students of the genus as above set forth, we may arrive at certain tentative conclusions, which at least serve as working hypotheses.

There is no doubt that former systematists conceived of species as being much more composite than they are at present regarded by many. The Linnaean conception prevailed. In older herbaria we often find two quite distinct forms, forms now regarded as different species, mounted on one sheet; this may be taken as evidence of the broader conception of species that formerly prevailed.

Recent workers who have been studying species closely, especially students using the culture method, find that many systematic species are made up of a number of distinct forms, or elementary species that breed true when propagated by seed. A notable illustration of this is *Draba verna*, which has been studied by Jordan. In many of the descriptions of species of *Crataegus* recently offered, lines have been drawn so closely, forms separated by such fine distinctions that we doubtless have descriptions of elementary species. But this can be proved only by long culture experiments.

I am inclined to think that a great many of the *Crataegus* forms we have are hybrids. European species are known to hy-

bridize; species in several other genera of the rose family hybridize freely. During the spring of 1908, I pollinated a few *Crataegus monogyna* (English hawthorn) flowers with pollen from *C. Brainerdi*, a native species. They set fruit which matured. During the flowering season of 1909, Mr. William Moore and the writer made cross pollinations between the majority of the native species of the local flora. Most of these cross pollinations were effective, — fruit set and matured, being entirely normal apparently. (These experiments are still in progress, the details of which will be published later.)

Within the past few decades, since the primitive forests have been cleared away, there has been an immense increase in the number of *Crataegus* plants growing. Being low trees or shrubs they cannot thrive in dense forests but spread freely over open pastures and along fence rows. The pasture southeast of the campus of Cornell University, a field of some twenty or twenty-five acres, has at least a thousand plants. This field has been allowed to run to pasture for the last twenty-five years or more, and *Crataegi* have thriven well. The original forest was cleared away years ago. The increase in number of plants makes cross pollination easier and much more probable. Bees and other insects swarm about the trees when they are in blossom, going from flower to flower and from tree to tree.

Irregularity in the number of stamens and pistils, variation in the shape of the leaves on the plant, variation in the color of the anthers (colors ranging from nearly white to dark purple intergrade), and the occurrence of plants possessing characters found in two distinct species growing near by, may all be taken as evidence of hybridity or progressive species. Numerous local species is another indication. There is scarcely a state that has not some species not found elsewhere; many of the species found in this immediate locality are different from species found at Rochester.

The fact that *Crataegus* plants seem to come true to type when grown from seed is a stumbling block in the way of a hybridity theory. However, it is possible that *Crataegus* hybrids are stable and come true to type when grown from seed. It cannot be said that they have been tested thoroughly until many mature plants have been grown.

Some of the points just made may be taken as evidence of mutations, but the best known mutants are not as irregular in characters as many of the species of *Crataegus*. Cultures carried through several generations are necessary in order to test whether or not *Crataegus* species throw off mutants.

I am greatly indebted to the gentlemen mentioned for their kindness in answering my questions, and to W. W. Eggleston, especially for data concerning the number of species attributable to the different authors.

CORNELL UNIVERSITY,
ITHACA, NEW YORK